PHOTODYNE INC.

CALIBRATION LAB

MODEL 118 AND MODEL 128

(11XE + 8XE) (12XE + 8XE)

FIBER OPTIC SETS

INSTRUCTION MANUAL

CALIBRATION LAB

CALIBRATION LAB

MODEL 118 AND MODEL 128

(11XE + 8XE) (12XE + 8XE)

FIBER OPTIC SETS

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FOURTH PRINTING, NEWBURY PARK, CALIFORNIA
UNITED STATES OF AMERICA

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We warrant each of our products to be free from defects in material and workmanship. Our obligation under this warranty is to repair or replace any instrument or part thereof which, within a year after shipment, proves defective upon examination.

To exercise this warranty, write or call your local PHOTODYNE Representative, or contact PHOTODYNE Headquarters in Newbury Park, California. You will be given prompt assistance and shipping instructions.

REPAIRS AND CALIBRATION

PHOTODYNE INC. maintains a complete repair and calibration service as well as a standard laboratory in Newbury Park.

To insure prompt repair or recalibration service, please contact your local field representative or PHOTODYNE Headquarters directly before returning the instrument.

Estimates for repairs, normal recalibrations and calibrations traceable to the National Bureau of Standards are availabe on request.

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Fig. 1 New Generation of Fiber Optic Instrumentation

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TABLE 1

SPECIFICATIONS

FUNCTION	8XE	11XE	12XE
Display	mA	dBm	dBm
Sensor	---	Si photodiode	Ge photodiode
Wavelength Range	---	350-1100nm	700-1800nm
Calibration Setting	---	820nm	1300nm
DC Power Range	---	-80 to 0dBm	-60 to 0dBm
Repeatability	.25% regulation	1%(0 to 60dBm) 10%(-70 to -80dBm)	1%(0 to -40dBm) 10%(-40 to -60dBm)
Calibration Accuracy (NBS Traceable)	---	±6%	±10%
Constant Current Output	1mA to 100mA Adjustable	---	---
Connector Interface	---	All Industry Connectors	All Industry Connectors

	COMMON PARAMETERS
Modulated Light Response:	DC and 1kHz to 500MHz (all intensity levels)
Battery:	9 Volt transistor-type (EVEREADY 522 or equal)
Battery Life:	20 hours (nominal)
Dimensions (LWH):	5.75 in. (14.6 cm) x 3.10 in. (7.6 cm) x 1.50 in. (3.8 cm) each module
Weight:	0.75 lbs. (35 grams) each module
Shipping Weight:	4 lbs. (1.9 kg)
Operation Temperature:	0 to 55° C
Relative Humidity:	0 to 95% R.H., non-condensing

QUICK INSTRUCTIONS

Assemble together (1) transmitter module (Model 8XE), (2) Power Meter (Model 11XE or 12XE), (3) PHOTODYNE LED source, (4) appropriate PHOTODYNE connector or bare fiber adaptor, and (5) "Dummy" test fiber (short length of fiber identical to fiber being measured).

1. Thread adaptor onto Power Meter sensor.
2. Plug in LED source to transmitter module.
3. Attach dummy fiber to LED source and to Power Meter.
4. Switch on both modules. Record the Power Meter reading (dBm).
5. Replace dummy fiber (between LED source and sensor) with fiber to be tested.
6. Record Power Meter reading (dBm).
7. Subtract value obtained in step 6 from readings in step 4. This gives the loss in fiber (dB) for the difference in lengths between the dummy fiber and the fiber under test. This loss is for both core and cladding light, unless cladding mode strippers are used!

   Example: Dummy fiber 1 meter long, test fiber 1000 meters long. Meter reading shows the loss for 999 meters (1000 meteres minus 1 meter).

This completes the measurement.

1. GENERAL INFORMATION

1.1. Introduction

PHOTODYNE Test Sets, Models 118 and 128, are used to make power loss (attenuation) measurements in optical fibers. The Set consists of separable transmitter and receiver units each powered by internal disposable 9V batteries, so that measurements can be made between the remote ends of an installed link. Optical coupling is by PHOTODYNE connector adaptors, available for all connectors used in the industry. The Model 118 Test Set is comprised of an 11XE Power Meter and an 8XE Power Source, plus accessories. A 128 Test Set is comprised of a 12XE Power Meter and an 8XE Power Source.

1.2. Features

The convenient test units are rugged enough to be thrown in a tool chest or carried on the belt. They feature:

* Pocket-size
* One-hand operation
* Autoranging over 8 decades (80dB) (118) and 6 decades (60dB) (128)
* Calibrated readout in dBm
* Resolution is 0.1dB
* Current regulation to 0.25% (for driving LED sources)

The Test Sets take advantage of the latest IC, display and packaging technology to achieve the lowest possible component count. This in turn ensures reliability, accuracy, stability and ruggedness.

Fig. 2 Adaptors for all-industry connector types, thread onto the built-in sensor of Models 11XE and 12XE Power Meters

Additional features:

* Liquid-crystal display (LCD) and CMOS circuitry for low power consumption and extended field operation.
* Uses standard 9 volt transistor battery for portable use or (supplied) battery eliminator for continuous AC line operation.
* Briefcase-style carry case, or pocket-type zipper pouch permits safe and convenient transportation.

1.3. Specifications

Detailed specifications for the Test Set are given in Table 1.

1.4. Accessories

Accessories include a broad line of plug-in LED sources (for Model 8XE), plus connector adaptors for all popular connectors in the industry. Table 3-2 lists the plug-in sources; Table 3-1 lists availabe connector adaptors. These accessories may be ordered with the Test Set or seperately from PHOTODYNE. Users outside the U.S. should contact the local PHOTODYNE Representative in their own country.

1.5. Instrument Identification

PHOTODYNE Test Sets are identified by serial number on the back of each module. Please refer to this number in discussing any malfunction or calibration question.

1.6. Instruction Manual

One manual is shipped with each Test Set. Additional manuals may be purchased from PHOTODYNE. Users outside the U.S. should contact the local PHOTODYNE Representative in their country.

1.7. Warranty Information

The warranty is stated on the inside front cover of the manual. If there is a need for service, contact your local PHOTODYNE Representative or PHOTODYNE Headquarters in Newbury Park, California. A warranty registration card is included with each new instrument. This card should be filled out and returned immediately after receipt and inspection.

1.8. Change Notice

Improvements or changes to the instrument not incorporated into the manual will be explained on a yellow change notice sheet attached to the inside back cover of the manual.

2. INITIAL INSPECTION

2.1. General

This section provides information needed for incoming inspection and preparation for use.

2.2. Inspection

Before shipment, this instrument was inspected and found to be free of mechanical and electrical defects. As soon as the instrument is unpacked, inspect for any damage that may have occured in transit. Save all packaging materials until inspection is completed. If damage is found, file claim with carrier immediately. PHOTODYNE Sales Office should be notified as soon as possible.

2.3. Mechanical Check

This check should confirm that there are no broken switches and that the meter is not cracked or scratched.

2.4. Electrical Check

The instrument should be checked against its electrical specifications (See Section 7).

Fig. 3 Model 118-S Fiber Optic Test Set

2.5. Contents

MODEL 118-S

Fiber Optic Test Set in case including:

- 1 Model 8XE Optical Transmitter
- 1 Model 11XE Optical Receiver
- 1 Model 1006 LED source, 820nm with 50/125 Fiber Pigtail
- 1 Model 2019 Bare Fiber Adaptor
- 1 Model 115B Power Supply *

MODEL 118-A

Fiber Optic Test Set in case including:

- 1 Model 8XE-A Optical Transmitter with built-in 820nm, LED source with AMP receptacle
- 1 Model 11XE Optical Receiver with Model 2001 AMP connector adaptor
- 1 Model 1225A, 50/125 Fiber Cable, 25cm long terminated both ends with AMP connectors
- 1 Model 115B Power Supply *

MODEL 118-B

Fiber Optic Test Set in case including:

- 1 Model 8XE-B Optical Transmitter with built-in 820nm, LED source with Amphenol SMA receptacle
- 1 Model 11XE Optical Receiver with Model 2003 Amphenol SMA connector adaptor
- 1 Model 1225B, 50/125 Fiber Cable, 25cm long terminated both ends with Amphenol SMA connectors
- 1 Model 115B Power Supply *

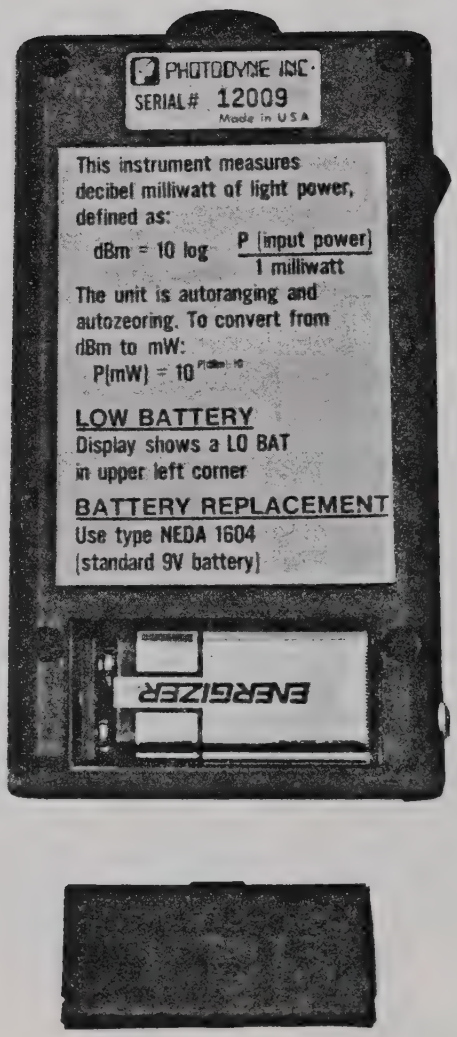

PHOTODYNE INC.
SERIAL# 12009
Made in USA
This instrument measures decibel milliwatt of light power, defined as:
dBm = 10 log P (input power) / 1 milliwatt
The unit is autoranging and autozeoring. To convert from dBm to mW:
P(mW) = 10
LOW BATTERY
Display shows a LO BAT in upper left corner
BATTERY REPLACEMENT
Use type NEDA 1604 (standard 9V battery)
ENERGIZER

Fig. 4 Battery compartment of Model 8XE with cover removed

MODEL 128-S

Fiber Optic Test Set in case including:

- 1 Model 8XE Optical Transmitter Module
- 1 Model 12XE Optical Power Meter, calibrated at 1300nm
- 1 Model 1009 LED source, 1300nm, with 50/125 Fiber Pigtail
- 1 Model 2019 Bare Fiber Adaptor
- 1 Model 115B Power Supply *

MODEL 128-B (for SMA, Amphenol SMA 905/906 or similar)

Fiber Optic Test Set in case including:

- 1 Model 8XE Optical Transmitter Module
- 1 Model 12XE Optical Power Meter, calibrated at 1300nm
- 1 Model 2003 Amphenol SMA (or similar) Adaptor
- 1 Model 1009B LED source, 1300nm with 50/125 Pigtail terminated with Amphenol SMA connector
- 1 Model 115B Power Supply *

Accessories as ordered.

Having verified the correct contents of your shipment, carefully read the instructions given in the following section on Preparation for Use.

* US and Canada. See Table 2-1 for other countries.

2.6. Preparation for Use

The Model 118 (128) Test Set is shipped ready-to-use. The Test Set modules are powered from replaceable 9 volt batteries. (EVEREADY 522 or similar).

Battery installment/replacement

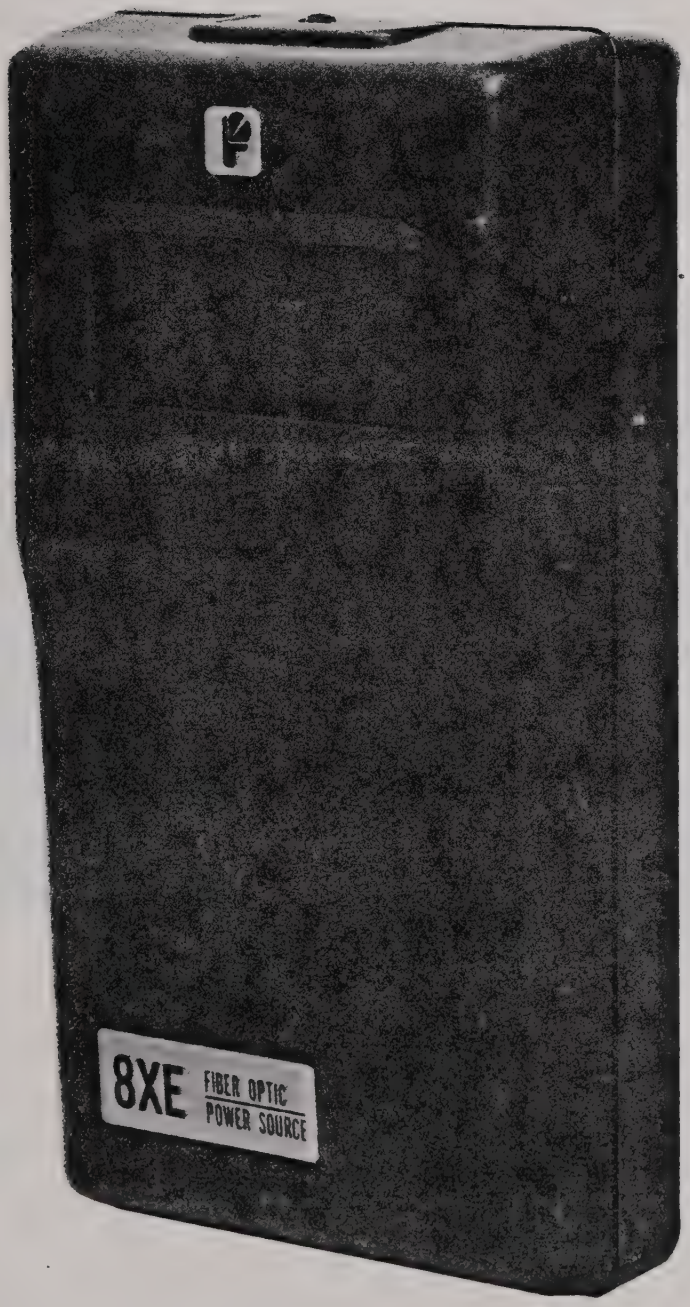
The batteries come already installed inside the Test Set units. The battery is a single transistor-type unit with two polarized connector posts on top. The battery is the equivalent of EVEREADY 522 and may be reordered as PHOTODYNE Model 522. To install or replace the battery, hold the instrument in hand so that the back side faces up. The battery compartment opening is on the lower section of the back side. Place both thumbs over this lid and push down and out. Note the position of battery and lead wires. Replace the new battery in exactly the same position as the old one. When replacing the battery compartment lid, put the lid in place and push down and forward until the lid snaps into a lock position.

How to check the battery

Whenever a Test Set module is on, the battery condition is continuously monitored. A low battery condition exists when the battery voltage falls below 7.2 volts. This is indicated by a LO BAT appearing in the upper lefthand corner of the LCD display. If the LO BAT appears, or the instrument does not operate at all, first suspect a discharged battery and change according to the procedures given above.

Battery eliminator/power supply

The input jack at the right side of the instrument is for a battery eliminator power supply. When one of the PHOTODYNE



Battery
Eliminator
Jack

Fig. 5 Model 8XE Optical Power Source

model numbers listed in Table 2-1 is plugged into this jack, the internal battery is automatically disconnected, and the power supply takes over.

NOTE: A NINE VOLT CHARGER CANNOT BE USED; A NINE VOLT POWER SUPPLY MUST BE EMPLOYED

TABLE 2-1

BATTERY ELIMINATOR/POWER SUPPLY SELECTION CHART

PHOTODYNE Model #	Available AC Power	Country
100B	90 - 110 VAC, 50 Hz	Japan
115B	105 - 127 VAC, 60 Hz	U.S., Canada
220B	198 - 242 VAC, 50/60 Hz	Europe

Fig. 6 Model 11XE Power Meter with Optional Zipper Pouch (Model 4002)

3. DESCRIPTION

3.1. Optical Power Meters

Model 11XE and Model 12XE are calibrated Receiver Modules, differing in their spectral range. Model 11XE covers from 400nm to 1100nm (calibration set for 820nm), while Model 12XE covers from 800nm to 1800nm (calibration set for 1300nm). The 11XE has a built-in large area silicon sensor, and the 12XE a germanium sensor. Dynamic range of the 11XE is up to 80dB (from 1mW to 10pW) with 0.1dB resolution. Dynamic range of the 12XE is 60dB (from 1mW to 1nW), with .1dB resolution. These instruments feature an assortment of interchangeable threaded adaptors to accommodate most Fiber Optic connectors on the market, plus adaptors for bare Fiber Pigtails. (See Table 3-1 and 3-2).

3.2. Optical Power Source

The PHOTODYNE Model 8XE is a pocket-sized, Power Source for driving light emitting diodes (LED's). It has an adjustable constant current output over the range 1mA to 100mA. The general purpose 8XE will accept any of PHOTODYNE's optional plug-in sources (see Table 3-2). This is the most versatile of the 8XE transmitter modules.

Models 8XE-A and 8XE-B have built-in LED-sources at 820nm and will accept only AMP Optimate and Amphenol SMA connectors, respectively. The 8XE series feature a large 3-1/2 digit LCD readout. Calibration is in milliamperes and readout shows the actual current driving the LED source. The current flow is regulated to 0.25% and adjustable from 1mA to 100mA.

TABLE 3-1

CONNECTOR ADAPTORS

At this printing, the following connector adaptors are available:

Model	Description
2000	Fiber Optic Adaptor Set
2001	AMP Optimate Single Fiber Adaptor
2001A	Hi-Profile AMP Adaptor
2002	Siecor Adaptor
2003	Amphenol SMA Adaptor
2004	Augat Adaptor
2005	Blank Adaptor
2005A	Hi-Profile Blank Adaptor
2006	Deutsch Standard Adaptor (DW1000 or DWR1000 Series)
2008	Bare Fiber Adaptor W/Magnetic Clamp
2009	Hewlett-Packard SMA Adaptor
2010	ITT FON Adaptor
2011	Suhner AG Adaptor
2012	NEC/JAE Type FOJD (Japan) Adaptor
2013	ITT Canon FOT/OCN Adaptor
2014	Hughes (2nd Generation) Male Adaptor
2015	Hughes (2nd Generation) Female Adaptor
2016	Deutsch DW4000 (Terminus) Adaptor
2017	Western Electric (WECO) LA1A Adaptor
2018	Siemens Adaptor
2019	Precision Bare Fiber Adaptor
2020	Radiall SMA Adaptor
2021	NTT/JAE - Type FOJC (Japan) Adaptor
2022	AMP DNP Adaptor
2023	Bare Fiber to AMPH SMA Adaptor (50/125)
2024	Bare Fiber to AMPH SMA Adaptor (100/140)
2025	Switchcraft FC Adaptor
2026	HP HFBR-0500 Series Adaptor
2027	Diamond AS Adaptor
2028	Hughes (1st Generation) Male Adaptor
2029	Hughes (1st Generation) Female Adaptor
2030	Mohawk Adaptor
2031	Sumitomo Mini-BNC Adaptor
2032	JAE - Type FOJA SMA (Japan) Adaptor

Note: This list is constantly being updated. When looking for particular connector adaptor, if it is not shown above, please check with PHOTODYNE.

TABLE 3-2

PLUG-IN SOURCES

Plug-in LED sources are used with Model 8XE. Available sources, as of this printing, are listed below:

Model	Description
1001	LED Pigtail Source, 900nm, 1mm dia. fiber
1001A	Model 1001 with AMP connector
1001B	Model 1001 with AMPH SMA connector
1002A	Source Module, 900nm, AMP receptacle
1002B	Source Module, 900nm, AMPH SMA
1003	LED Pigtail Source, 820nm, 100/140 micron fiber
1003A	Model 1003 with AMP connector
1003B	Model 1003 with AMPH SMA connector
1004A	Source Module, 820nm, AMP receptacle
1004B	Source Module, 820nm, AMPH SMA receptacle
1005A	Dual Source Module, 820nm, AMP
1005B	Dual Source Module, 820nm, AMPH SMA
1006	LED Pigtail Source, 820nm, 50/125 micron fiber
1006A	Model 1006 with AMP connectors
1006B	Model 1006 with AMPH SMA connectors
1007	Dual Pigtail Source, 820nm, 50/125 micron fiber
1007A	Model 1007 with AMP connectors
1007B	Model 1007 with AMPH SMA connectors
1008	LED Pigtail Source, 1220nm, 50/125 micron fiber
1008A	Model 1008 with AMP connector
1008B	Model 1008 with AMPH SMA connector
1009	LED Pigtail Source, 1300nm, 50/125 micron fiber
1009A	Model 1009 with AMP connector
1009B	Model 1009 with AMPH SMA connector

4. OPERATING INSTRUCTIONS

4.1. General

This section provides information needed to use the Model 118 and 128 Test Set. First, basic units of fiber measurements are presented. The following sections detail the operation of the 11XE, 12XE and 8XE.

4.2. Fiber Optic Measurement Units

Optical radiation power is defined in terms of watts and sub multiples thereof: milliwatts (10^{-3}W), microwatts (10^{-6}W), nanowatts (10^{-9}W) and picowatts (10^{-12}W). Since light power intensities can range over fifteen decades, logarithmic units are very convenient. Decibel light power is computed with the formula:

$$(1) \qquad dB = 10 \log \frac{P_{sig}}{P_{ref}}$$

where P_{sig} is the power to be measured and P_{ref} is the reference power.

If the reference power is 1 milliwatt (as with the 11XE and 12XE), eqn. (1) becomes:

$$(2) \qquad dBm = 10 \log \frac{P_{sig}}{1\ mW}$$

In order to convert a dB measurement to watt units, the following equation is obtained from (1):

$$(3) \qquad \frac{P_{sig}}{P_{ref}} = 10^{dB/10}$$

for dBm conversions:

$$(4) \qquad P(mW) = 10^{dBm/10}$$

4.3. Models 11XE and 12XE

The rocker switch provides three modes of operation: POWER ON (down position), POWER OFF (center or neutral position) and POWER ON W/BACKLIGHT (up position). The user should limit his use of the backlight function to conserve battery life. A "LO BAT" indicator will appear in the upper lefthand corner of the LCD display when the battery should be replaced. AC line operation is accomplished using the battery eliminator module supplied (specified by customer requirements (See Table 2-1). These wall plug-in AC line adaptors are plugged into the battery eliminator jack located on the side of the instrument. When one of the power supplies is used, the battery is electrically disconnected from the active circuit.

The models read out directly in units of decibel milliwatts (dBm). Resolution is 0.1dBm. Actual measurement is performed by coupling the light source to the sensor; this can be done using the PHOTODYNE Fiber Optic adaptors. For absolute results, the instrument should have been previously calibrated at the wavelength of the source (See Calibration Procedures).

4.4. Model 8XE

The rocker switch provides power selection: POWER ON (down position) and POWER OFF (up position). A "LO BAT" indicator will

Fig. 7 Current Adj. Source receptacle

Model 8XE

appear in the upper lefthand corner of the LCD display when the battery should be replaced. AC line operation is accomplished using the battery eliminator module supplied with the 8XE (specified by customer requirements (See Table 2-1). These plug-in AC line adaptors are plugged into the battery eliminator jack located on the side of the instrument. When one of the above power supplies is used, the battery is electrically disconnected from the active circuit.

In operation, the drive current is externally adjustable via trimpot R51 accessible from the hole located on the rear panel of the 8XE (next to output port). For drive currents over 50mA, the AC line adaptor must be used since battery operation is inadequate.

There are three versions of the Model 8XE Fiber Optic Power Source. The standard Model 8XE is universal, allowing use of the PHOTODYNE plug-in LED sources. This unit provides a regulated electrical output via a miniature jack located at the rear of the instrument. The Models 8XE-A and 8XE-B incorporate internal LED's with a Fiber Optic receptacle for direct coupling to AMP Optimate and Amphenol SMA connectors, respectively. Thus, these latter models provide an optical output via an internal LED source which is electrically driven and regulated.

NOTE: The display on Model 8XE is the driving current (mA) for the LED source being used. This reading should not be confused with the measurement being performed, which will always be read at the Power Meter (Model 11XE/12XE).

Fig. 8 The Optical Power Source from the Model 8XE is coupled to the sensor head of the Power Meter.

5. APPLICATIONS

5.1. General

This section provides information necessary to use the Fiber Optic Test Set for the measurement of optical Power Sources in absolute units of dBm, cable transmission loss measurements in dB, splice and connector losses in dB and receiver responsivity. From these measurements the fiber cable loss in dB/km and the total system loss in dB may be stated.

5.2. How to Measure Optical Power

The optical source from the Model 8XE is coupled to the sensor head of the Power Meter (Model 11XE, 12XE), using one of the PHOTODYNE connector adaptors (see Table 3-1). If a user-selected external source is used it may be connected to the Power Meter in a similar manner. Alternatively, a source traveling through free air may be measured under laboratory conditions where all ambient light is excluded.

NOTE: Be sure that the sensor calibration and the LED central wavelength are compatible (Model 11XE at 820nm, Model 12XE at 1300nm).

Optical power in absolute units (dBm), will be displayed and read off the Power Meter. In recording the reading, the drive current from the 8XE should be noted and made part of the report.

5.3. How to Measure Optical Transmission Loss

The power output of the source is one of the factors involved in the calculation of fiber loss, which is most conveniently

represented by the cable-loss factor (CLF) in dB/km:

$$CLF = \frac{P_i - P_o}{L} \qquad (1)$$

where

P_1 = Input power in dB

P_o = Output power in dB

L = Cable length in km

The power output of the source is easier to measure than the effective input power to the fiber. Loss mechanisms extract a heavy toll on light sent to the fiber's core; for example, not all of the source light falls on the core and the launch angle may direct some of the light into the fiber cladding.

The cable-substitution method can be used to find the CLF even when the launched power is unknown. The substitution method involves comparing the power outputs of two unequal lengths of otherwise identical cables. For both cables, the power sources, the source-to-cable coupling and the unknown amounts of power actually launched into the core are identical. Hence, the following equation gives the CLF:

$$CLF = \frac{P_1 - P_2}{\Delta L} \qquad (2)$$

where

P_1 = Power out of cable 1 in dB

P_2 = Power out of cable 2 in dB

ΔL = Difference in cable lengths in km

The cables should be long enough so that light initially coupled into the cladding will die out, ensuring that the output powers measured come solely from the cores. Alternatively, light propagating in the cladding can be "stripped out" by submersing the cable, for a short distance near the launching end, in a fluid or gel with a refractive index that matches the cladding's refractive index.

Loss measurements can be made on one cable alone if the cable can be cut. The output power level is measured before and after a piece is cut from the cable. The two measurements are substituted for the P_1 and P_2 values in Eq. 2, to determine the dB loss. The advantage of this scheme is that it does not require two separate but identical cables and launching conditions.

5.4. How to Measure Connector and Splice Loss

The difference between the optical power input and the optical power output of a connector or splice equals either the connector loss or the splice loss. Making measurements directly in dB simplifies the required calculations. If the connector in question is attached to a long cable, the CLF must be subtracted from the total loss measured for the connector.

The overall measure of power losses from a system may not correlate to the manufacturer's specifications for losses from individual components. Some makers of connectors specify the loss both for light coupled into the fiber core and for light coupled into the cladding. However, cable specifications often include only the light coupled into the core. In addition to the losses specified for connectors and cable, an accurate appraisal of total-link loss requires measurement of the loss into fiber cladding at a connector interface.

For measurement results closest to most manufacturers specs, use both cladding mode strippers and mode equalizers on the light input and light output side of the connector under test. (See references 1, 2 and 3 for a description of these components and their effect on measurement results).

5.5. Calibrating Receiver Responsivity

The term responsivity (R) is used to describe the sensitivity of the optical receiver and is the ratio of the output current to the input flux in watts. When the responsivity is indicated at a particular wavelength (R (λ) in amperes/watt), it connotes the spectral response of the device).

To calibrate the spectral response of an optical receiver proceed as follows:

1. Close couple the optical source to the Power Meter (Model 11XE for 820nm, Model 12XE for 1300nm).
2. Note Power Meter reading (dBm). This is the absolute power of the source.
3. Close couple the receiver being calibrated to the same source and in identical manner as in step 1.
4. Connect a precision ammeter to the output leads of the receiver under test.
5. Note the ammeter reading. This is the receiver photocurrent.
6. Calculate receiver spectral responsivity from:

$$R\ (\lambda) = \frac{A}{W}$$

where:

A = Photocurrent (step 5)
W = Optical Power in watts (step 2)

(To convert log power to linear power see conversion table inside back cover).

CAUTION: The operational limit of an optical receiver is the maximum power that the device can absorb before going non-linear. With steady-state power the optical flux to a Model 11XE, for example, must not exceed a photocurrent of greater than 1.0mA. If the incident flux energy is in the form of a transient pulse of less than a few microseconds duration, the maximum allowable photocurrent is 120mA. For unknown devices being calibrated check with the device manufacturer for the operational or saturation limit.

6. THEORY OF OPERATION

6.1. General

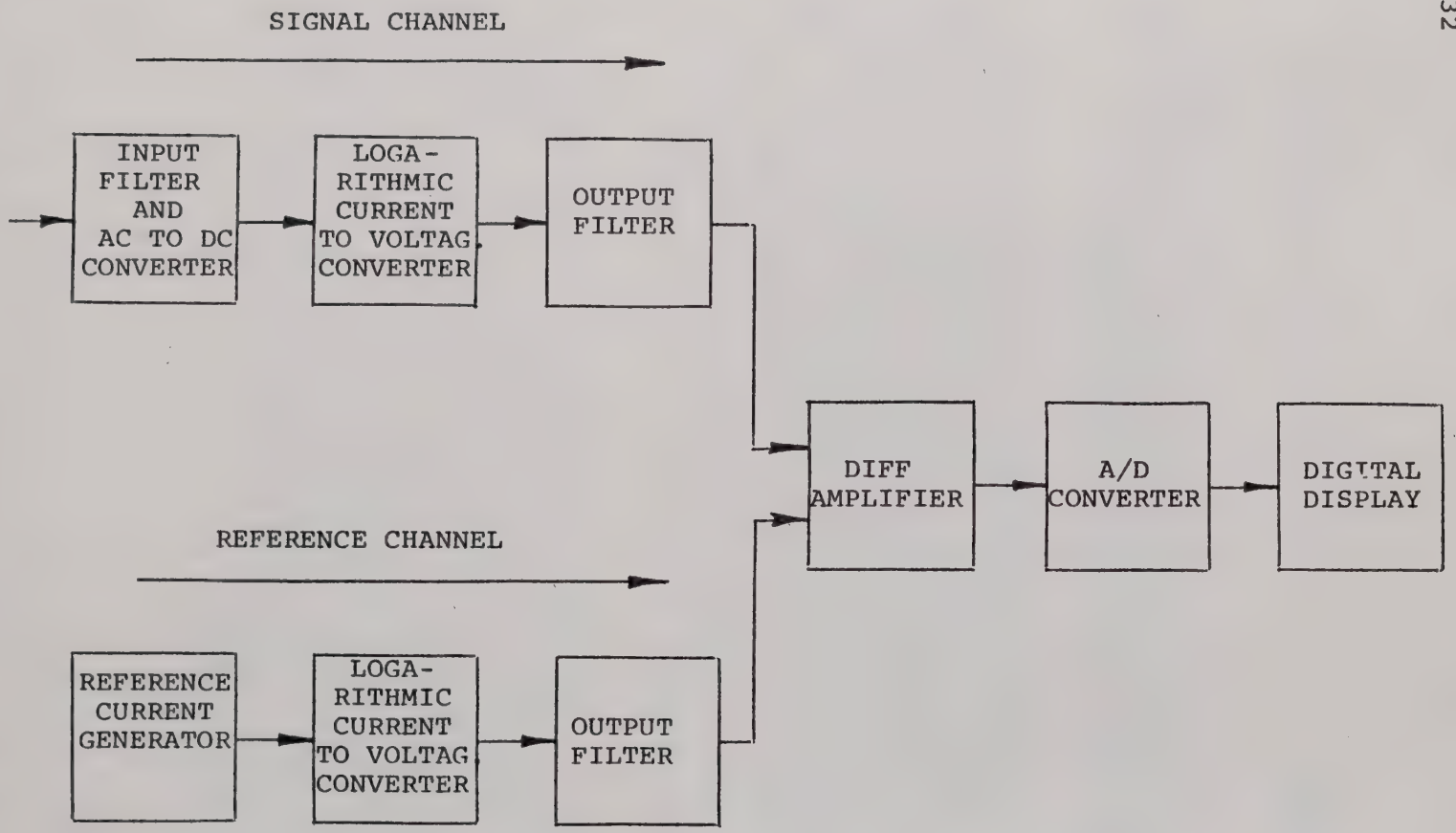
This section contains information describing the operation of the Model 11XE (12XE) Fiber Optic Power Meter.

The electronics are all arranged on a single board, including battery, switch and display. This board is operational even when removed from the case. However, low signal level performance is lost without the shielding provided by the case. Circuitry breaks down into three parts: (1) current to voltage conversion of sensor signal currents, (2) voltage reference generation from the sensor head trim resistor, and (3) analog to digital conversion and display. Fig. 6 shows an overall block diagram for the 11XE (12XE) electronics.

Optical power measurements with the 11XE (12XE are accomplished) by taking the sensor head output signal current, which is linearly proportional to the input optical power, through a current to voltage, logarithmic, transimpedance amplifier, resulting in an output voltage. This voltage, together with a voltage from the gain determining amplifier, is fed to a ratio mode A/D converter. All amplifiers are chopper stabilized for autozeroing and minimum temperature drift. Average power of modulated optical signals is measured by converting the AC signals to DC amplification.

6.2. Sensor Heads

PHOTODYNE Sensor Heads are comprised of silicon (11XE) or germanium (12XE) photodiodes. This signal current from the photodiode is linearly related to the input optical power. The conversion factor is called responsivity (amps/watt). All calibrations are traceable to the National Bureau of Standards.


SIGNAL CHANNEL
INPUT FILTER AND AC TO DC CONVERTER
LOGA-RITHMIC CURRENT TO VOLTAG CONVERTER
OUTPUT FILTER
REFERENCE CHANNEL
REFERENCE CURRENT GENERATOR
LOGA-RITHMIC CURRENT TO VOLTAG CONVERTER
OUTPUT FILTER
DIFF AMPLIFIER
A/D CONVERTER
DIGITAL DISPLAY

7. MAINTENANCE

7.1. General

This section contains information necessary to maintain the Model 11XE (12XE). Included are procedures for Electrical Performance Checks and Calibration.

7.2. Required Test Equipment

Recommended test equipment for check and maintaining the instrument are given in Table 7-1. Test equipment other than recommended may be substituted if specifications equal or exceed the stated specifications.

TABLE 7-1

RECOMMENDED TEST EQUIPMENT FOR PERFORMANCE VERIFICATION

Item	Description	Minimum Specifications	Mfg.	Model
A	Calibrated Source	.01 to 1 mW 820nm/1300nm	Photodyne	8XE (with appropriate source, see Table 7-1)
B	Nanoampere Source	1,10,100 uA @.25% 1,10,100 nA @. 6%	Keithley	225
C	Voltmeter Digital	10V @ 1%	Fluke	8020A

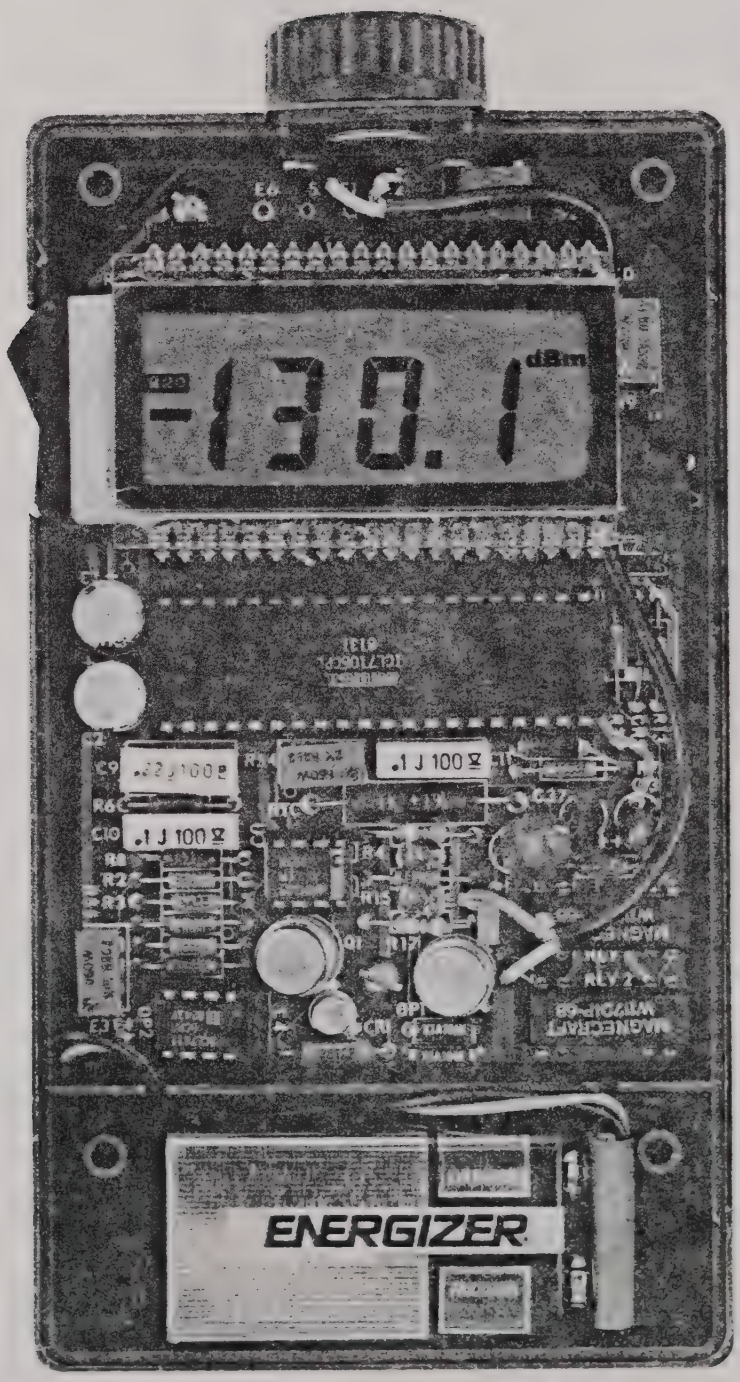


Fig. 9 Model 11XE (12XE) Power Meters

7.3. Calibration Procedure for 11XE/12XE

Performance verification and calibration of the Model 11XE/12XE consists of three parts: (1) electronics verification, (2) low battery indicator check and (3) spectral calibration.

(1) Electronics Verification:

The operation of the 11XE/12XE can be verified using a precision current source such as the Keithley Model 261 Picoampere Source. The instrument is essentially a specialized picoammeter and therefore a current source can be used to simulate the detector photocurrent output.

NOTE: Model 12XE has a zero potentiometer that must be adjusted before proceeding. The screwdriver slot to this potentiometer is located in the hole adjacant to the sensor head. Place the black cap over the sensor and adjust the potentiometer for a reading between -65dBm and -110dBm on the 12XE meter. (This procedure is not required with the 11XE).

Attach the black cap (supplied) over the sensor head and connect the current source to Model 11XE/12XE via (+) pad E1 and (-) pad E2. Adjust the picoampere source for a display reading of 00.0 on the 11XE/12XE. This will usually require a current input between 200 and 600 microamperes. Change the current level in uniform decade steps, i.e. down one decade, two decades, three decades, etc. When down three decades, -30.0 dBm should appear on the display. If this is not the case, adjust trimpot R54 until -30.0 is obtained. Now decade down to -40.0, then back up to -30.0, -20.0, -10.0 dBm. The display should never deviate more than +/- 1% and +/- 1 count from absolute

value down to -50 dBm. When finished, disconnect the current source and remove blank cap from sensor to restore normal operation.

(2) LO BAT Indicator:

Disconnect battery by removing battery compartment on bottom side of instrument. Attach an adjustable DC power supply to the battery connector terminals. Observe correct polarity! Adjust output of power supply to 7.4 volts and adjust trimpot R59 (near LCD) until LO BAT indicator just disappears on LCD display. Adjust supply over range 7-10 volts. Below 7.4 volts, the LO BAT indicator should appear. Above 7.4. volts, the indicator should be off. Disconnect power supply and reinsert battery. LO BAT should not appear unless battery condition is low.

(3) Spectral Calibration:

The spectral calibration of the 11XE is maintained via a silicon detector reference standard; the 12XE is via a germanium detector standard, traceable to the National Bureau of Standards (NBS). Calibration is performed by use of a stable light source of the appropriate wavelength characteristics (such as the output of a monochromator, LED or Fiber Optic Source, as desired). Minimum output of the transfer source should be 10 microwatts for best results. The source output is then measured with a reference detector or radiometer system. This measurement is then transfered to the Power Meter to produce a corresponding reading on the LCD.

Standard calibrations at 820nm (11XE) and 1300nm (12XE) are performed with a special Pigtail LED Source connected to a Model 2003 Amphenol SMA adaptor and driven by a Model 8XE Power Source. First, this source assembly is con-

nected to a Sensor Head (specially calibrated) which is inserted into a PHOTODYNE Model 22XLA Fiber Optic Multimeter. Next, the absolute output of the source is measured with the multimeter system. This source assembly is then connected to the 11XE or 12XE. Internal trimpot R55 is adjusted until the same reading is obtained.

7.4. Calibration Procedures for Model 8XE

Performance verification and calibration of the Model 8XE consists of two parts: (1) electronics verification, and (2) low battery indicator check.

(1) Electronics Verification:

Electrical operation of the 8XE can be verified using an accurate digital multimeter such as the Keithley 191 or similar. All models of the 8XE can be electrically verified and calibrated in terms of LED drive current and the display value. If Model 8XE-A or 8XE-B is being tested, one of the LED leads must be unsoldered (disconnect lead to pad E1).

Connect the positive lead of the multimeter to either the wire leading to E2 or to the top of R1 (use most convenient point). Then, connect the negative (or common) probe of the multimeter to E1 or E6 (whichever is more convenient again). Adjust trimpot R51 until a positive reading of 25.0 mA is shown on the multimeter display. Then, adjust trimpot R50 until an LCD readout of 25.0 is obtained. By varying the setting of R51, the resulting output current should correspond to the LCD display value. (All 8XE readings should be within 0.5% and 2 counts). Reconnect the LED to E1 for Models 8XE-A or 8XE-B.

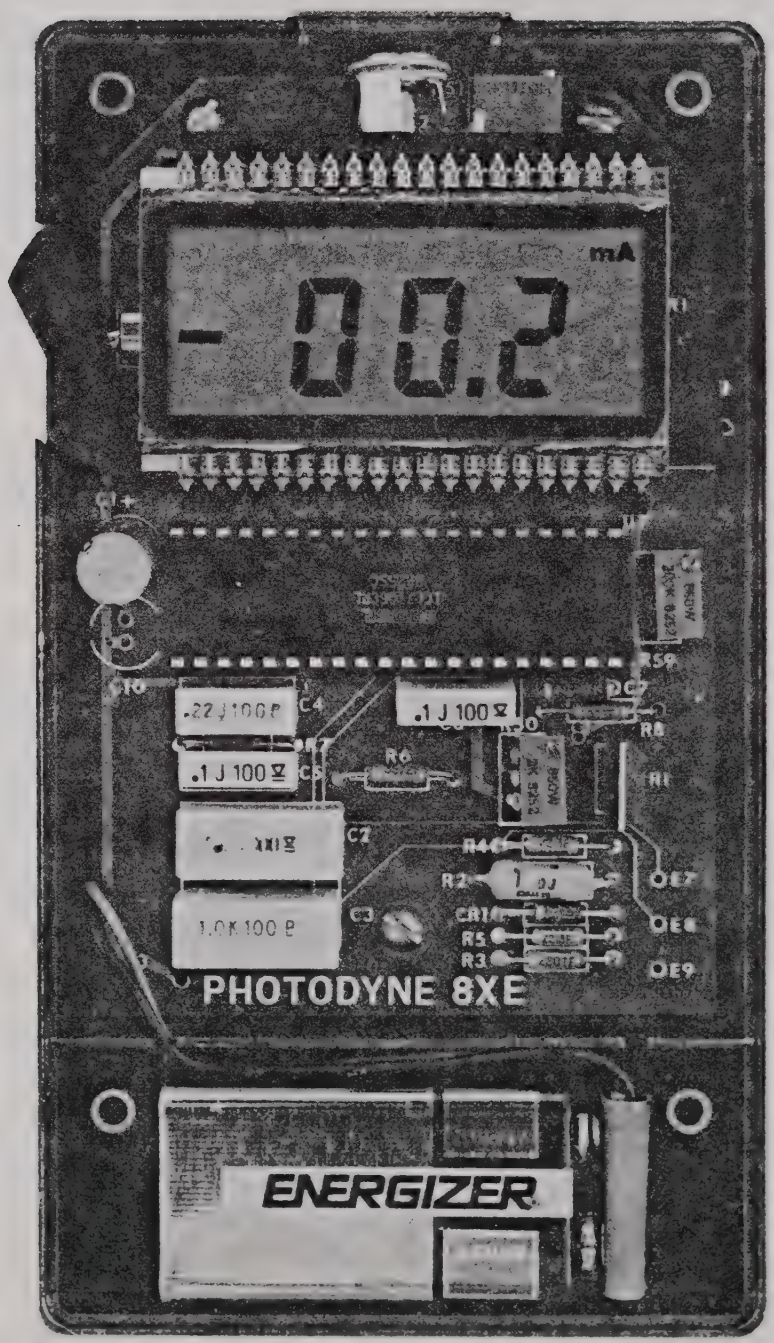


Fig. 10 Model 8XE Optical Source Driver

(2) LO BAT Indicator:

Disconnect battery by removing from battery compartment on bottom side of instrument. Attach an adjustable DC power supply to the battery connector terminals. Observe correct polarity! Adjust output of power supply to 7.4 volts and adjust trimpot R59 (near LCD) until LO BAT indicator just disappears on LCD display. Adjust supply over range 7-10 volts. Below 7.4 volts, the LO BAT indicator should appear. Above 7.4 volts, the indicator should be off. Disconnect power supply and reinsert battery. LO BAT should not appear unless battery condition is low.

There is no spectral calibration of the output of the Model 8XE Series. The 8XE functions as a regulated current source.

8. REPLACEABLE PARTS

8.1. General

This section contains information for ordering replacement parts.

8.2. Ordering Information

To place an order or to obtain information concerning replacement parts, contact your local PHOTODYNE Representative or PHOTODYNE Headquarters. When ordering, include the following information:

(a) Instrument Model Number

(b) Instrument Serial Number

(c) Parts Description

REFERENCES:

R. Cooper, "Connector Splice Loss Measurements: The Laboratory Versus the Real World" IFOC Vol. 3 3/4 (1982).

D.L. Franzen, G.W. Day and R.L. Gallawa, "Standardizing Test Conditions for Characterizing Fibers" Laser Focus Vol. 17 8 (1981).

D. Charlton and P.R. Reitz, "Making Fiber Measurements" Laser Focus Vol. 15 9 (1979).

A.H. Cherin and W.B. Gardner, "Fiber Measurement Standards", Laser Focus Vol. 16 8 (1980).

PHOTODYNE INC.
1175 Tourmaline Drive
Newbury Park, California 91320
Phone: (818) 889-8770 Telex: 18-1159

DATE _____

RMA NO. _____

SERVICE FORM

MODEL NO. _____ SERIAL NO. _____ P.O. NO. _____

NAME _____ TITLE _____

COMPANY _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

PHONE NO. (_____) _____ EXTENSION _____

(1) Describe problem and symptoms using quantitative data whenever possible (enclose readings, chart recordings, etc.)

_____

_____

_____(Attach Additional Sheets)

(2) Show a block diagram of your measurement system including all instruments connected (whether power is turned on or not). Also describe the signal source.

(3) List the positions of **all** controls and switches on both front and rear panels of the instrument

_____

_____

(4) Describe input signal levels, frequencies, etc. _____

_____

_____

(5) List and describe all cables used in the experiment (length, shielding, etc.). _____

_____

(6) List and describe all other equipment used in the experiment. Give control settings for each.

_____

_____

(7) Environment:

Where is measurement being performed? _____

What power line voltage is used? _____

Ambient temperature? _____

°F Variation? _____ °F Rel. Humidity _____

Other _____

(8) Additional information. _____

_____

DATA CONVERSION TABLE

DB = LINEAR

DB	LINEAR
+ 30.0	1000.
+ 20.0	100.0
+ 10.0	10.00
+ 9.5	8.912
+ 9.0	7.943
+ 8.5	7.080
+ 8.0	6.310
+ 7.5	5.623
+ 7.0	5.012
+ 6.5	4.467
+ 6.0	3.981
+ 5.5	3.548
+ 5.0	3.162
+ 4.5	2.818
+ 4.0	2.512
+ 3.5	2.239
+ 3.0	1.995
+ 2.5	1.778
+ 2.0	1.585
+ 1.5	1.413
+ 1.0	1.259
+ 0.5	1.122
0.0	1.000

DB	LINEAR
0.0	1.000
- 0.5	0.891
- 1.0	0.794
- 1.5	0.708
- 2.0	0.631
- 2.5	0.562
- 3.0	0.501
- 3.5	0.447
- 4.0	0.398
- 4.5	0.355
- 5.0	0.316
- 5.5	0.282
- 6.0	0.251
- 6.5	0.224
- 7.0	0.200
- 7.5	0.178
- 8.0	0.159
- 8.5	0.141
- 9.0	0.126
- 9.5	0.112
- 10.0	0.100
- 20.0	0.010
- 30.0	0.001

$$DB = 10 \text{ LOG } \frac{P1}{P2}$$

www.manualsplus.com
1028945

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